W5AWS Mobile Dual-band Antennas

Contents

1 Motivation....1
2 Scope....1
3 Antennas....2
3.1 Diamond NR-770HA....2
3.1.1 NR-770HA Measured SWR....3
4 Conclusions....4
5 Addendum....4
6 Lessons Learned....5
7 Glossary....5

Figures

Figure 1: NR-770HA on tripod....1
Figure 2: Antenna mounting....2
Figure 3: Diamond NR-770HA official SWR response curves....3
Figure 4: Antenna configuration block diagram....3
Figure 5: Mounting plate detail....4

Tables

Table 1: SWR comparison between advertised and measured values....3
Table 2: RigExpert AntScope SWR plots for 2 m & 70 cm bands....4

1 Motivation

Figure 1: NR-770HA on tripod

My interest is minimalist flexibility, low power, and easily portable equipment that allows me to assemble and disassemble a station anywhere. At first, I became active with a Yaesu FT-70D handheld VHF/UHF radio; to that equipment, I added a Yaesu FT-818ND, an all-band QRP radio in a conveniently small package.

Though operating at QRP power levels has less reach, it eliminates need to worry about exposure to high levels of RF energy, and does make a DX contact more exciting. Also, there is the interesting challenge to do more with less.

Consequently, I don't have a fixed station or the bother of installing and maintaining an antenna array. I operate from any convenient location.

2 Scope

In this document, I look at using portable transceivers in the home environment where establishing a permanent shack isn't possible or necessarily desirable. I prefer to make-do with what I've got, which enables me to get going almost anywhere, avoiding permanent installation.

Another aspect is operating during stormy weather when connecting to an external antenna risks the danger of electrocution from a lightning strike. At times like this, a good portable antenna for making contact with the local repeaters is useful, like that shown in Figure 1.

3 Antennas

One of the first things experienced users of handheld transceivers tell new owners to do is to replace the supplied “rubber duck” antenna with an after-market model for better performance. I tried several, settling on a Diamond SRH77CA, which is touted as giving 6dB gain over the original equipment delivered with the radio.

It works, but I must still move to places in the house where I can make solid contact with the local VHF or UHF repeaters.

At the October 2021 meeting of TARC, Greg, W5GGW, explained that the body holding the HT acts as a ground-plane for the antenna, and that best radiation pattern is when the operator holds the antenna vertical.

An HT is useful, but not always in an enclosed environment. During the same club meeting just mentioned, both W5GGW and Mark, WA5MA, recommended using a mag-mount dual-band antenna on a filing cabinet or cookie sheet ground plane for those who contact repeaters through an HT.

I often put my HT on a stand and with it use a Heil Sound single-side handy-talky headset when joining the local repeater nets.

For the next TARC Net, after the TARC meeting in October, I mounted a Diamond NR-770HA radialless dual-band antenna on a tripod connected via adapters and RG-58 coax to the HT, as shown in Figure 2. Instead of the Heil Sound headset, I used a Yaesu SSM-17A speaker-microphone, allowing me to demonstrate combined phone and CW operation on the repeater with the help of my FT-818ND sidetone in practice mode.

Figure 2: Antenna mounting

Combined phone and CW operation on the repeater was proof-of-concept for a future CW practice net on a stand-alone repeater.

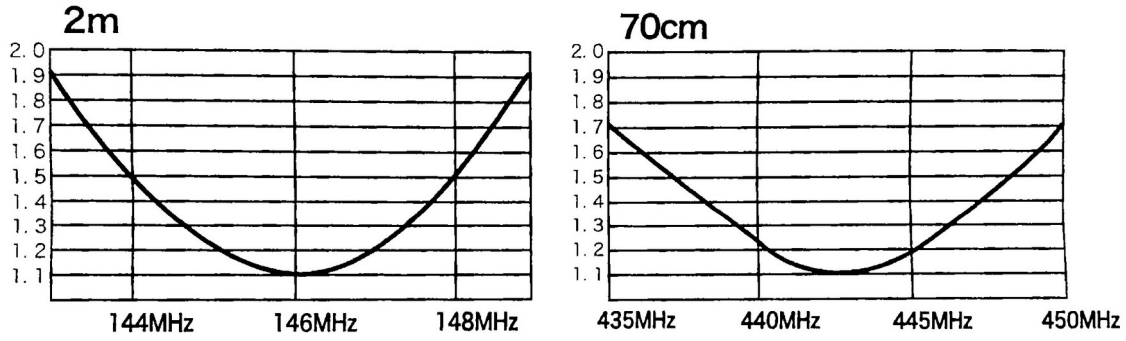
3.1 Diamond NR-770HA

Putting the NR-770HA on a tripod allowed me to move it to location where it provided solid contact with the repeater, orient it vertically, and have enough coax cable for me to sit at a comfortable location.

Diamond advertise the NR-770HA as giving 3dB gain on 2 m and 5.5dB gain on 70 cm. Signal report into the 443.850 super-link repeater was good, and into the 145.110 repeater as very good, significantly better than on 70 cm.

Antenna gain is rarely as good as advertised. Actual performance is best judged by signal reports from receiving operators. However, I did wonder about the actual SWR of the NR-770HA antenna, deciding to measure it with an antenna analyzer. Diamond publish frequency-scan curves for their antenna, reproduced in Figure 3.

Figure 3: Diamond NR-770HA official SWR response curves



3.1.1 NR-770HA Measured SWR

Measured SWR across the 2m band is quite good, but not as good as advertised by Diamond.

Figure 4: Antenna configuration block diagram

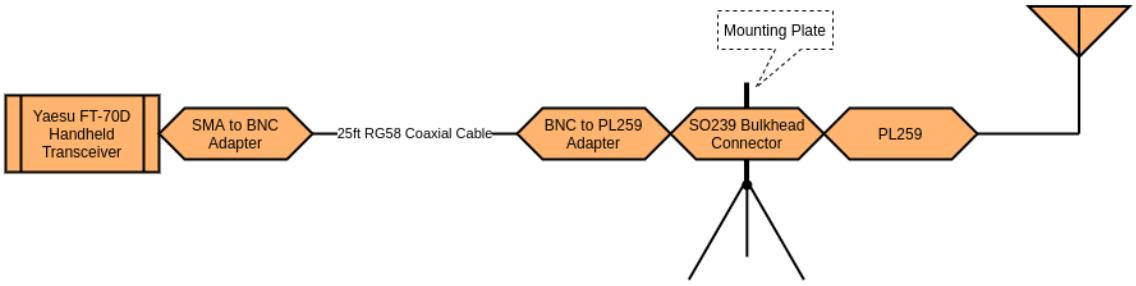


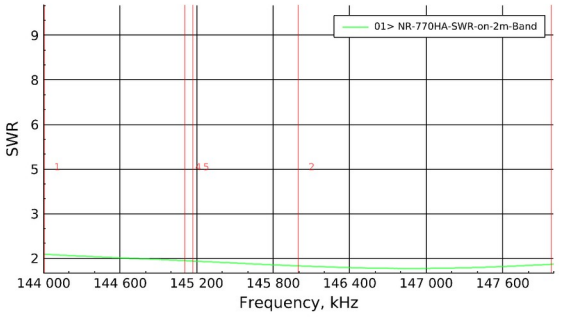
Figure 4 is an overview of my antenna configuration, and the comparison between the advertised and measure SWR is tabulated below in Table 1 with data drawn from the SWR plots shown in Table 2.

Table 1: SWR comparison between advertised and measured values

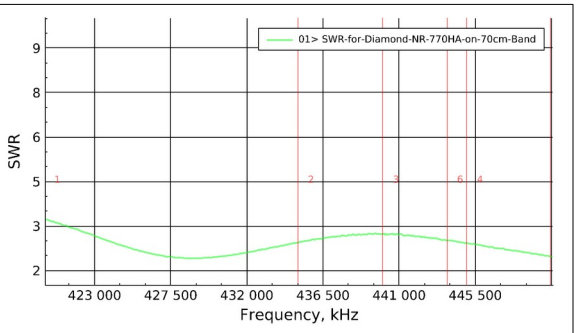
Frequency	Advertised SWR	Measured SWR	Marker
144.000	1.50	1.65	1 near 2 m lower band edge
146.000	1.10	1.26	2 near 2 m band center
148.000	1.50	1.31	3 near 2 m upper band edge
145.110	—	1.43	4 near 145.110 west Tulsa Repeater
145.170	—	1.41	5 near 145.170 east Tulsa Repeater
420.000	—	3.23	1 near 70 cm lower band edge
435.000	1.70	2.46	2 near 435.000
440.000	1.25	2.74	3 near 440.000
445.000	1.19	2.44	4 near 445.000
450.000	1.70	1.99	5 near 70 cm upper band edge
443.850	1.15	2.53	6 near 443.850 TARC superlink

See Table 2 for the RigExpert AntScope SWR plots for the 2-meter and 70-centimeter bands; 2 m at left, 70 cm at right. I was unable to locate the markers exactly on the frequencies of interest; I don't know why I couldn't, but it may be because I don't know enough about how to use AntScope, hence the discussion of markers being "near" frequencies of interest. It's probably close enough not to make any difference. I did try changing the resolution of the plots from 100 to 500 points.

Table 2: RigExpert AntScope SWR plots for 2 m & 70 cm bands



Marker	#	FQ, kHz	SWR	RL, dB	Phase°	R, Ohm	X, Ohm	Z, Ohm
1	1	144004.14	1.65	12.23	51.48	62.25	25.34	62.25 + j25.34
2	1	145997.93	1.26	18.93	37.19	59.29	8.21	59.29 + j8.21
3	1	147983.45	1.31	17.51	100.21	46.12	12.30	46.12 + j12.30
4	1	145108.58	1.43	15.04	37.35	64.59	14.33	64.59 + j14.33
5	1	145170.63	1.41	15.31	36.78	64.32	13.62	64.32 + j13.62

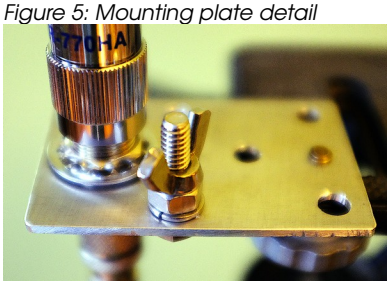


Marker	#	FQ, kHz	SWR	RL, dB	Phase°	R, Ohm	X, Ohm	Z, Ohm
1	1	420031.02	3.23	5.55	-95.91	26.01	-37.84	26.01 - j37.84
2	1	435015.51	2.46	7.50	14.44	113.82	29.10	113.82 + j29.10
3	1	440041.37	2.74	6.65	-34.11	87.84	-58.48	87.84 - j58.48
4	1	445005.17	2.44	7.57	-70.88	45.79	-43.87	45.79 - j43.87
5	1	449937.95	1.99	9.62	-108.40	33.81	-23.79	33.81 - j23.79
6	1	443826.27	2.53	7.28	-62.89	51.25	-48.58	51.25 - j48.58

4 Conclusions

As you can see in Table 1 and Table 2, the measured 2 m SWR is comparable to the values advertised by Diamond — on 2 m, the length of the antenna is a ½ wave. On 70 cm, the measured SWR is significantly different to that advertised by Diamond. I don't know why this should be so, but it explains why my signal report though acceptable on 70 cm wasn't as good as it was on 2 m. On this band, the NR-770HA is designed to operate as a ⅝ wave two-element collinear antenna.

Figure 5: Mounting plate detail



Though the NR-770HA is a radialless design, the mounting plate shown in Figure 5 has a ¼″×20 screw-stud and wingnut to allow connection of ground-plane radials for other vertical antennas that need them.

5 Addendum

During the November 20th 2021 TARC Net, we heard an operator who had very clear and solid reception by the repeater. Mark, WA5MA, inquired about his rig. He reported that he was using a transceiver connected to an N9TAX Labs Slim-Jim dual-band roll-up antenna mounted in his attic. WA5MA recommended the antenna as a suitable standby for a go-bag that can be hoisted into a tree when needed. Jack, W5JHC, concurred with WA5MA, saying that he is impressed by performance of the Slim-Jim he owns. More information is available at https://n9taxlabs.com/.

6 Lessons Learned

During an excursion to Chandler Park earlier this year for portable operation, WA5MA offered me the use of a balun. Unfortunately it was equipped with SO-239 connectors that prevented me from testing it because all my connectors are BNC. After that experience, I acquired a variety of adapters that allow me to mix and match SMA, BNC, UHF, and N-type connections. Having these adapters available made this antenna exploration immediately easy.

7 Glossary

BNC.....Bayonet Neill–Concelman
cm.....Centimeters
CW.....Continuous Wave, synonymous with Morse code
dB.....Decibel or $\frac{1}{10}$ Bel
DX.....Telegraphic shorthand for “distance” or “distant”
GHz.....$\times 10^9$
HT.....Handheld Transceiver, otherwise know as a *Handy-Talky*
Hz.....Hertz, cycles per second
m.....Meters
MHz.....$\times 10^6$
N-type.....A connector capable of carrying microwave-frequency signals, named after its inventor in the 1940s by Paul Neill of Bell Labs.
QRP.....Telegraphic code for reduce-power, also for operating power of 5W or less
SMA.....SubMiniature version A
SWR.....Standing Wave Ratio
TARC.....Tulsa Amateur Radio Club
UHF.....Ultra High Frequency, 300 MHz to 3 GHz
VHF.....Very High Frequency, 30 to 300 MHz
W.....Watts